things than they have ever done, but we think they will have to undergo a certain discipline of conversion, and forget a good deal of interior competitive struggle, and of the outlook connoted thereby, before they qualify for the premier position in the world's markets.

THE CONSTITUTION OF COAL.

Monograph on the Constitution of Coal. By Dr. M. C. Stopes and Dr. R. V. Wheeler. (Department of Scientific and Industrial Research.) Pp. 58+plates iii. (London: H.M.S.O., 1918.) Price 2*s.* net.

IT is not too much to say that this monograph forms the most important contribution to our knowledge of what coal is, that has yet appeared; the problem has been tackled in the right spirit and by workers with the right kind of experience—namely, by a palæobotanist and a chemist working in conjunction. They themselves define the object of their research as an attempt "to discover what the present actual structure of a bituminous coal most usually is," and they further define what they understand by coal in the following words: "Ordinary coal is a compact stratified mass of 'mummified' plants (which have in part suffered arrested decay to varying degrees of completeness), free from all save a very low percentage of other matter." They themselves admit that this definition is not satisfactory; in particular it suffers from lack of precision, as much depends upon the sense in which the words "very low percentage" are used; it evidently includes lignite, which is perhaps intentional, but it also must include peat, which it was probably intended to exclude.

The monograph naturally falls into two main parts, dealing respectively with the chemical and the structural aspect of coal. The former discusses in much detail the composition of the various component parts that have been more or less completely identified, and relies mainly upon its division into two distinct types of compounds, distinguished as the "cellulosic" and the "resinic," the distinction being based essentially upon the solubility of the latter in pyridine, first discovered by Bedson.

In the latter portion much weight is given to the work of Lomax, which showed that ordinary bituminous coal is a humic accumulation in which, not chiefly wood, but leaves, twigs, fructifications, and other plant fragments preponderate, the term "humic" being used to indicate that the accumulation consisted of the largely undecayed mixed organs of plants. The various distinguishable plant remains are described and discussed, the most important being the woody cells, bark, including cork cells, cuticle, spore-coats and spores, seeds, and soft-walled tissue; it is shown that, with the exception of resin, the cell contents of the plants are but imperfectly preserved in coal.

The authors summarise their researches by stating their opinion that coal consists essentially of a conglomerate of morphologically organised plant tissues, of plant substances devoid of morphological organisation, of the comminuted degradation products of both of these, and of "ulmins" produced therefrom. But it may fairly be said that the value of the work lies not only in this results already attained, but also in the numerous indications that it affords of the directions along which future researches upon this highly complex subject should be conducted. It is to be regretted that the printing has been very badly done, and that numerous clerical errors have been allowed to escape the proof-readers.

H. LOUIS.

ANALYSIS AND GEOMETRY.

(1) *Elementary Mathematical Analysis.* By Prof. J. W. Young and F. M. Morgan. Pp. xii+548. (New York: The Macmillan Co., 1917.) Price 11*s.* net.

(2) *A Course of Pure Geometry, containing a Complete Geometrical Treatment of the Properties of the Conic Sections.* By the Rev. Dr. E. H. Askwith. New edition. Pp. xi+284. (Cambridge: At the University Press, 1917.) Price 7*s.* 6*d.* net.

(1) THE aim of Messrs. Young and Morgan is very clearly explained in their preface. Their book is intended for first-year students in universities and colleges, and, without in any way neglecting practical methods and applications, they have properly laid stress upon fundamental ideas such as "function," "continuity," and so on. Thus the student is prepared in due time for more abstract and delicate theories, and preserved from the risk of becoming a mere calculating-machine.

The contents of the book are arranged in five parts. The first is introductory; it deals with the idea of a function and its geometrical representation, and gives a sketch of the theory of rational operations in algebra. Part ii. considers elementary functions, including the simply periodic ones; it also gives a chapter on computation, in which there is an account of the slide rule, and concludes with a chapter on implicit quadratic functions. Part iii. contains the elements of analytical geometry as applied to the straight line, circle, and conic sections. Part iv. comprises chapters on algebraic manipulation, tactic, the binomial theorem, complex numbers, polynomials, theory of equations, and determinants. Part v. deals with functions of two variables, and gives the elements of analytical solid geometry. Finally, there are a set of useful tables, and a detachable page from which a rudimentary slide-rule can be constructed.

The present reviewer has lately been giving lectures on similar, not to say identical, lines; the agreement in aim, choice of topics, and extent of treatment has been practically complete. It is an encouragement to find one's ideas of a suitable elementary college course so independently and strikingly confirmed. We believe that treatises of this kind will greatly help to establish a right

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system of teaching mathematics, not only in colleges, but also in schools, where antiquated methods are still too prevalent.

There is one omission in the book which is regrettable; the authors do not discuss the theory of *dimensions*. This is a much more important matter than it might be thought, especially when the student works geometrical exercises with numerical coefficients, so that the dimensions are partly latent. Far too often even an honours student fails to note that his answer must be wrong, because it does not satisfy the test of dimensions; and it is needless to emphasise the value of the theory in physics.

Typographically the book is all that could be desired, except that we should have preferred old-face figures in the tables. The diagrams are numerous, attractive, and well printed.

(2) The new edition of Dr. Askwith's elegant work differs from its predecessor mainly in defining the conic sections in the Greek way as sections of a cone. The earlier chapters (i.–viii.) on the triangle, circle, cross-ratios, etc., make this method easy, with one notable exception; unless we discuss complex points and lines by a purely geometrical method (such as that of v. Staudt), we are not justified in treating every figure consisting of a conic and a line as being projectively equivalent to a figure consisting of a circle and a line. This is the weak point of Dr. Askwith's book; it is not clear whether he is appealing, in the last resort, to algebra, or relying upon the exploded "principle of continuity." In other respects the treatise fully deserves the favourable reception which it has obtained.

G. B. M.

OUR BOOKSHELF.

Association: A Story of Man for Boys and Girls. By Edward B. Cumberland. Pp. 32. (Published by the author at "Le Chalet," Penn, Bucks., 1918.) Price 2*s*.

FOR nearly thirty years Mr. Cumberland has been headmaster of William Ellis School at Gospel Oak, and in convinced obedience to the founder's testament has been (since 1889) teaching "social science" to boys of ages from eight to eighteen—a remarkable record of pioneer work on lines which are sure to be widely followed in the near future. In other ways, too, with its early physics laboratory (1890) and its specially built geography room, the school has been in the front line, and we would heartily congratulate Mr. Cumberland on what he has achieved in spite of conditions often far from encouraging. He has expressed some of his ideals in an interesting little book which he calls "Association." The title refers to the author's reasoned belief that one of the factors of human progress has been association, co-ordination, the multiplying of inter-relations. He illustrates this in a retrospect of the ascent of man, and by showing how the individual finds himself and realises himself, both in body and mind, as an active social person.

The booklet seems to us better suited for adults than for boys and girls, for it is very tersely written. We cannot even refer to the many wise things that are said about home and school, work and play, town and country, civics and Nature-study; but the two dominant ideas are: (1) that "knowledge of Earth and its story helps to make man fitter for life on it, and also to raise him above it"; and (2) that the open secret of progress is to enter into more and more complex associations for noble ends, rising from school and family to community and city, and from nation to humanity. The booklet is an intensely personal document, revealing a fine purpose. There is a tiny fly in the ointment in the suggestion (on page 9) that "creatures that crawl" should be regarded with disgust.

Memoir of John Michell, M.A., B.D., F.R.S. By Sir Archibald Geikie. Pp. 107. (Cambridge: At the University Press, 1918.)

SIR ARCHIBALD GEIKIE has done a further service to British science in reviving the memory of John Michell, and in directing attention to his work in various fields. Geologists are familiar with Michell's name in connection with Jurassic strata, and especially with the "Lyas" that he traced from Somerset to Lincolnshire. It is unfortunate that this ancient quarryman's term should suggest, in its modern form, a pseudo-classical origin. Michell, after his retirement from the rectory of St. Botolph's, Cambridge, and from his brief tenure of the Woodwardian professorship of geology, continued, as rector of Thornhill, "those important investigations in physics and astronomy with which his name will always be associated." He died in 1793, before the experiment that he had designed for determining the earth's density could be carried out; but his apparatus came, through Wollaston, into the hands of his friend and correspondent Cavendish, who improved it in detail, and ungrudgingly acknowledged Michell as its originator. A long and interesting letter from Michell to Cavendish on the strata near Grantham is here published for the first time. In his frequent journeys from Thornhill to London he made observations at his halting-places, such as Greetham on the old North Road, and one feels that he would have hailed the work of his successor, William Smith, as confirming much that he had seen. In 1760, while still at Cambridge, he contributed a paper on earthquakes to the Royal Society, in which he urged that the initial shock is propagated by wave-motion through the earth.

This admirably printed and attractive work raises pleasant memories of the times when the "learned leisure" of our country clergy was often devoted to scientific culture. The divorce of clerical duties from collegiate fellowships, however desirable on both sides, has undoubtedly reduced the endowments of research. G. A. J. C.

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